

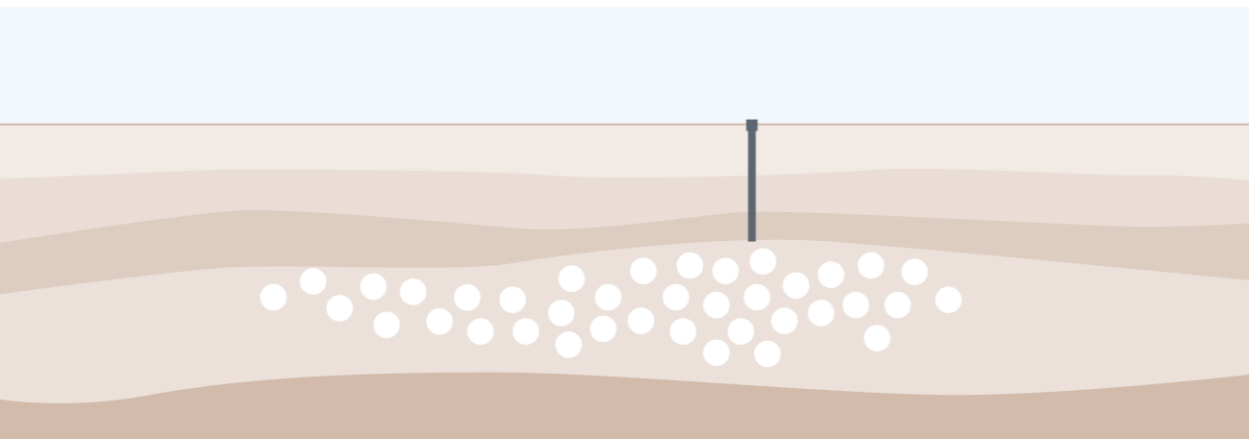
Preparing for Pressure

Well Control and Rig Readiness For CO₂ Operations

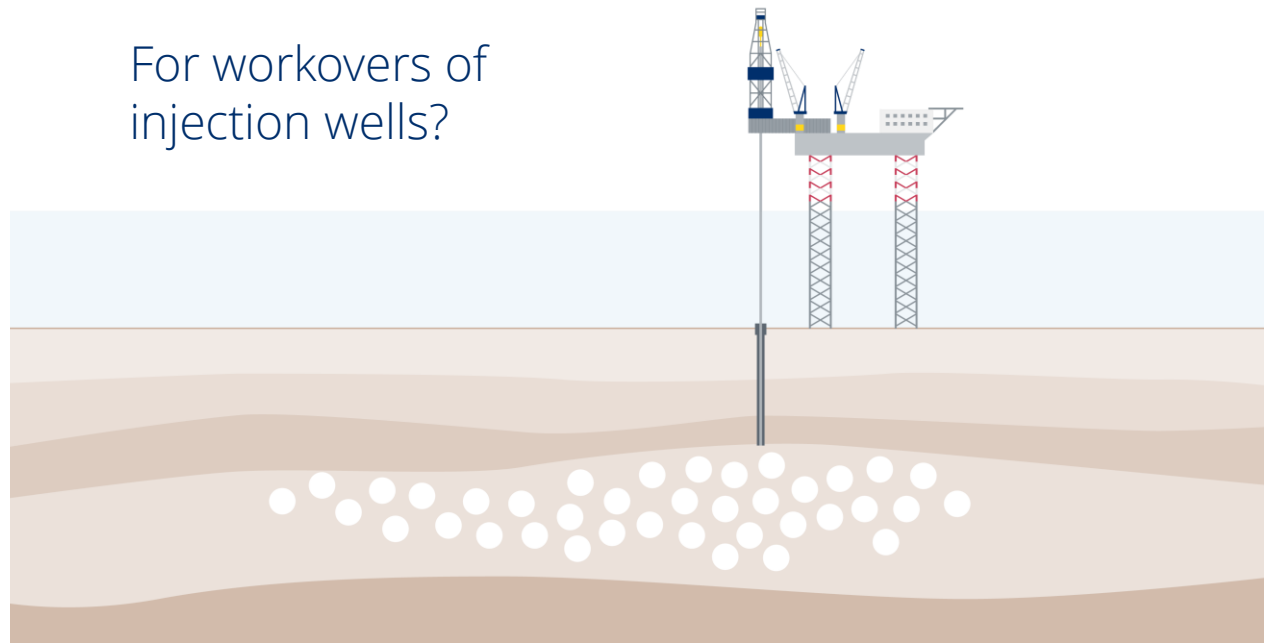
15 October 2025



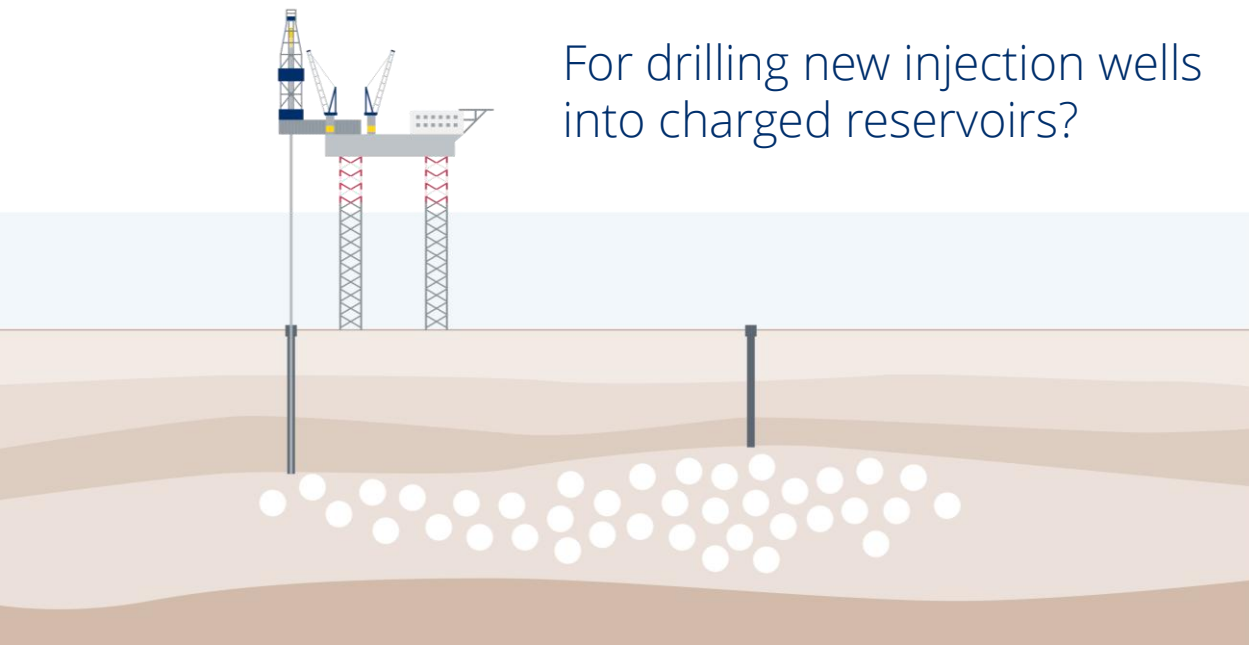
How do we de-risk operations with pressurized CO₂ downhole?



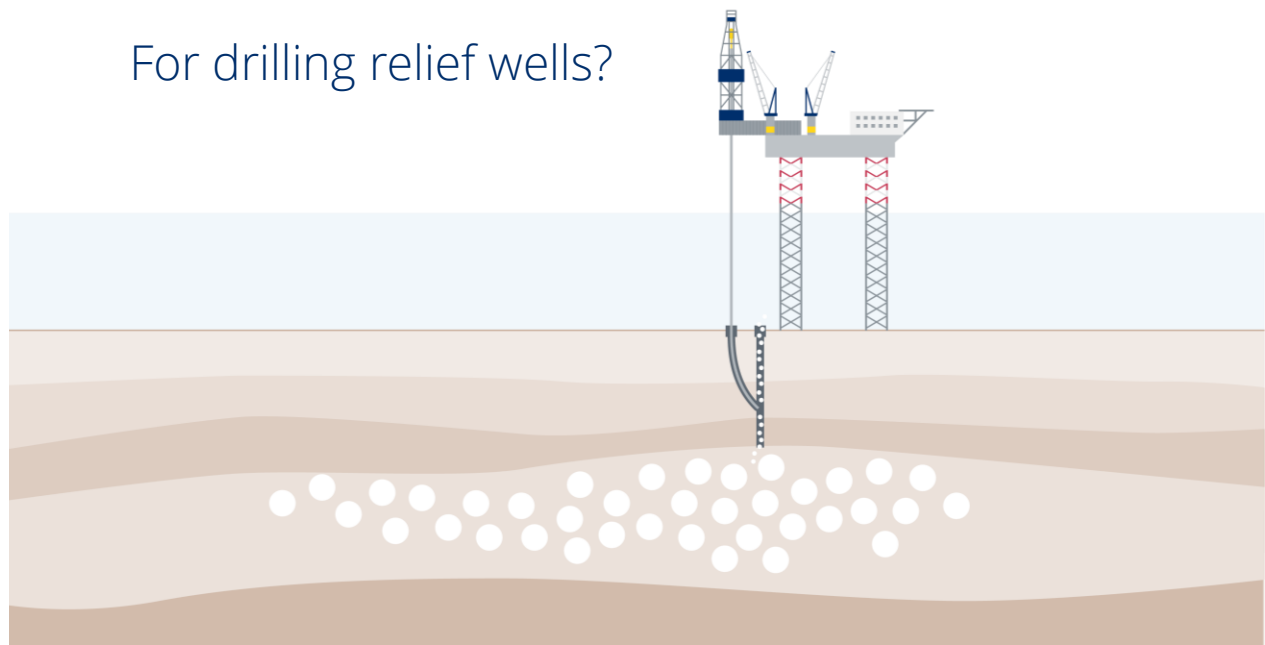
For workovers of injection wells?



For drilling new injection wells into charged reservoirs?



For drilling relief wells?



Video 1

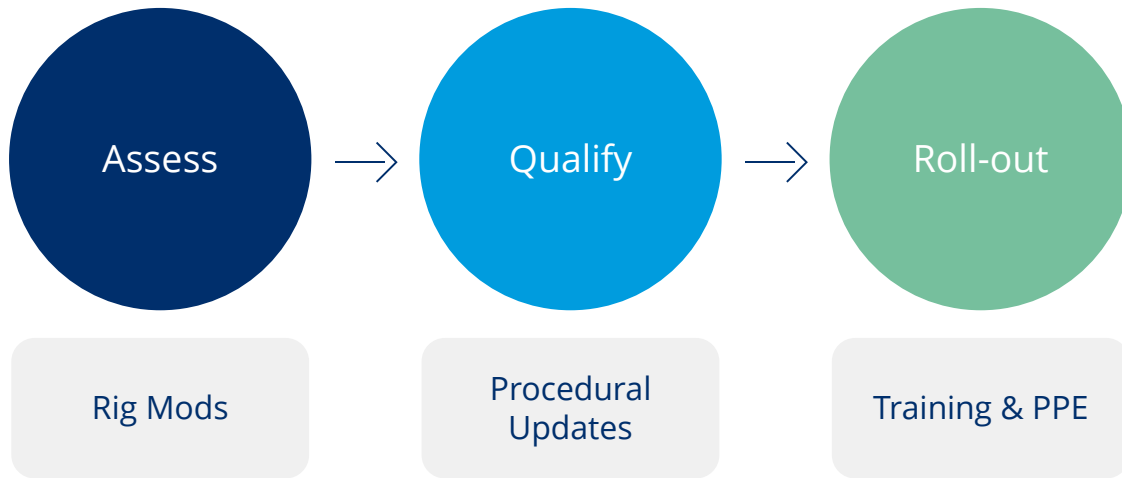


CO₂ Handling Package

De-risking CO₂ Operations Through Technology Qualification

To address the unique operational risks of offshore CO₂ wells, Noble partnered with DNV to conduct a formal technology qualification using DNV-RP-A203.

This structured process has helped us identify and **mitigate key failure modes**, supported by targeted testing, simulations, and collaborative studies focused on CO₂-specific behaviors and failure scenarios.



Project Greensand



Material Testing



CO₂ Rig Trial



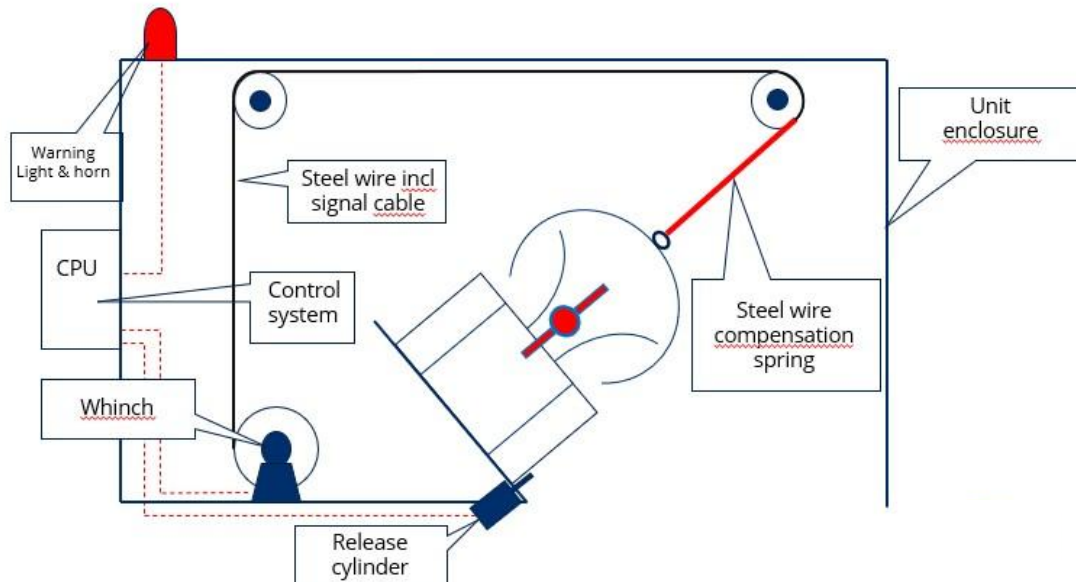
CO₂ Simulation

Emergency Response in a CO₂ Release Scenario

Conventional evacuation procedures require rethinking when dealing with heavier-than-air CO₂.

Noble has identified three critical upgrades to safeguard personnel:

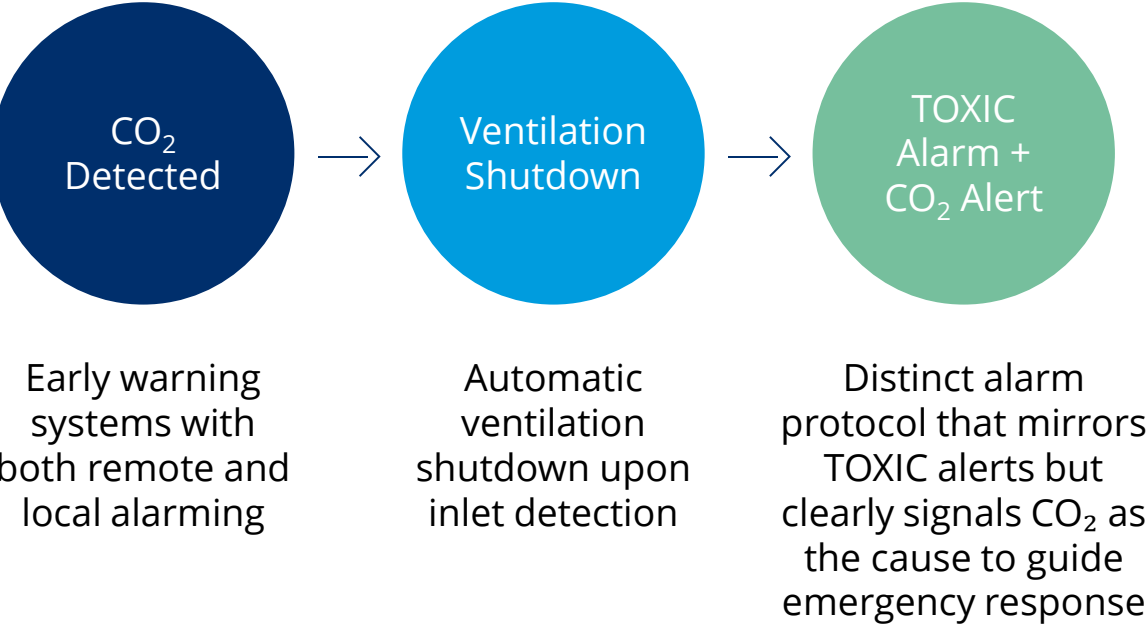
- Lifeboats with self-contained air support
- CO₂ wave-off lights for helicopters
- Sea-level CO₂ detection systems to prevent life-raft deployment into plumes



CO₂ Detection and Alarm Integration

Timely detection is critical in preventing personnel exposure during a CO₂ release.

Noble's approach includes:



Possible Solutions

Only 3 ways to certify well control equipment for a CO₂ environment:

1. Fully Upgrade the Whole System Including the BOP

+ **Pros:** Integrity, Reliability, Compatibility

÷ **Cons:** Cost, Lead times, Downtime

2. Conduct Materials Testing and Research to Certify the Legacy Package

+ **Pros:** Targeted upgrade, Preservation, Custom solution

÷ **Cons:** Uncertainty, Time-consuming, Research costs, Approvals

3. Install a CO₂ Grade Bypass System to Circumvent the Legacy Package

+ **Pros:** Cost-effective, Faster, Lower risk

÷ **Cons:** Integration, Logistics, Limited redundancy

When factoring in costs, timelines, and risks – we determined option 3, installing a CO₂ grade bypass system, to be the clearest path to success.

	
STATEMENT OF QUALIFIED TECHNOLOGY	
Statement No: 2024-2147	
This is to state: that the technology designated CO2 drilling unit / rig has been qualified for its designated use with basis in DNV-RP-A203 /1/ as defined in /2/.	
Owner:	Noble Drilling Corp
Description:	Performing drilling, workover / intervention and plug and abandonment operations with drilling rigs/units where CO2 may be encountered in well control scenarios, as further detailed in /3/
Designated use:	On CO2 storage and injection wells for drilling activities as further detailed in /3/
Involvement:	DNV has been involved in the qualification process in accordance with /2/. DNV has facilitated the technology qualification process with the aim at preparing the Noble Corp drilling rigs for use with Carbon Capture and Storage (CCS) development projects. Noble has detailed out plans for rig readiness activities in preparing for upcoming potential drilling, workover / intervention and plug and abandonment operations with drilling rigs/units. In the technology qualification work, no showstoppers are currently foreseen towards rig readiness for CO2 drilling operations.
Limitations:	Acceptance criteria for products and limits to operation are stated in /3/, the main ones being: Noble Corp and its partners have performed technology qualification activities towards rig readiness. When preparing drilling units / rigs, the key focus topics going forward, as individual rig readiness preparations are performed include: 1. Material and equipment suitability, with three potential mitigation options: A. Designing and implementing a CO2 diverter system which isolates the drilling rig from CO2 in case of a CO2 well control scenario B. Upgrade(s) to existing rig equipment with material and equipment qualified for CO2 drilling and well control load scenarios C. Testing existing equipment to attempt to prove its worthiness for CO2 drilling rig operations 2. Well control risk mitigation of well control for CO2 drilling operations
Conditions:	Information which may affect the technology qualification status shall be brought to the attention of the below signatories immediately.
Reference documents:	/1/ DNV-RP-A203, Technology qualification, September 2019. /2/ DNV-SE-0160, Technology qualification management and verification, February 2018. /3/ DNV Report 2424-1526 Noble CCS Drilling Rig TQ Report, Rev. 0, 2024-08-02.
This Statement is valid until: 2028-10-22	
Issued at Esbjerg, Denmark on 2024-10-22	
for DNV	
	
Lars Henning Pedersen Head of Department	Jesper Skott Jensen Project Manager
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Form code: TQ 321	Revision: 2024-10
www.dnv.com	Page 1 of 1

Introducing the Electrical CO₂ Enabler (ECE)



Video 2



Electrical CO2 Enabler

Choke Station

Transfer Station

Electrical Support Station

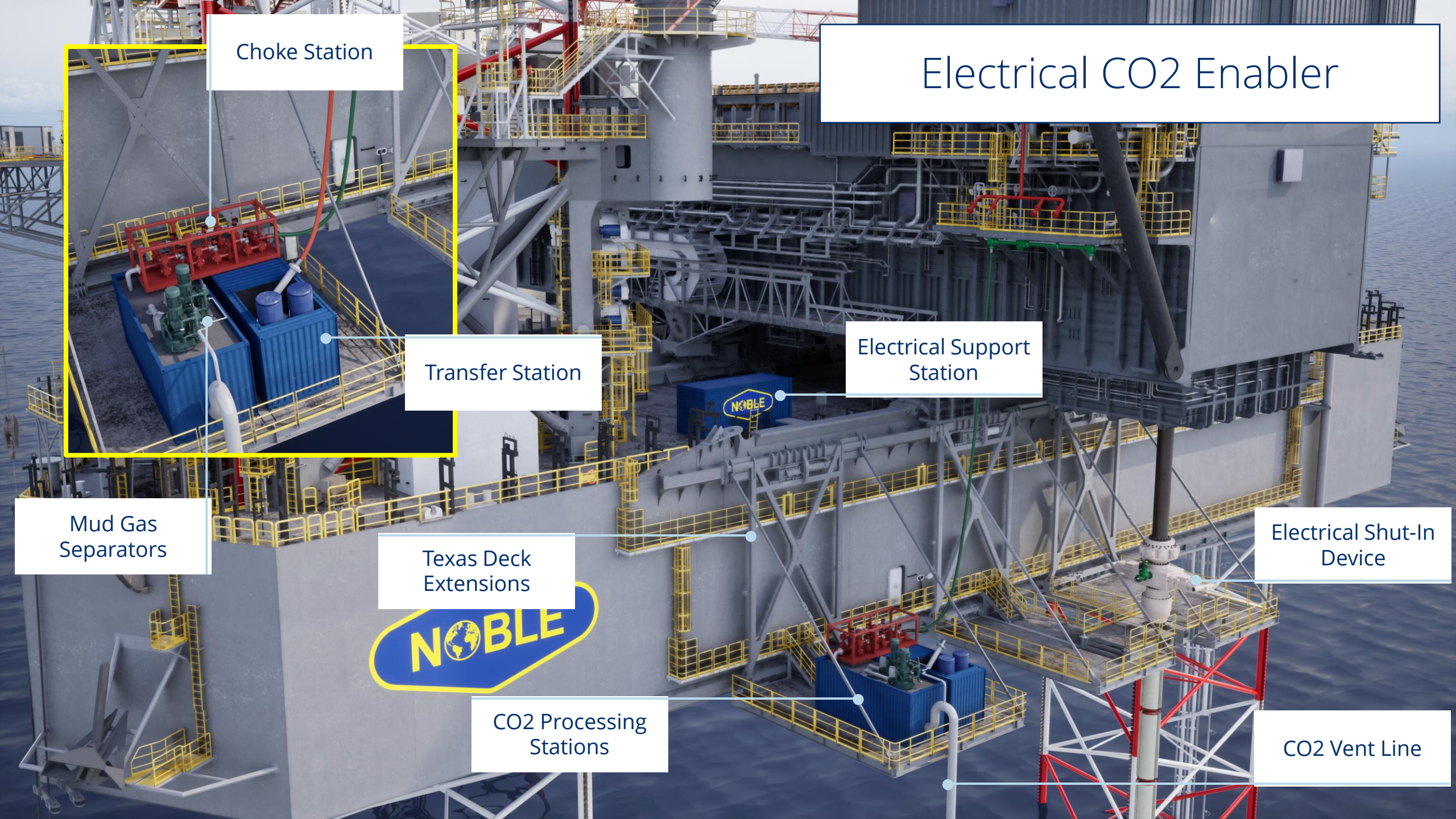
Mud Gas Separators

Texas Deck Extensions

Electrical Shut-In Device

CO2 Processing Stations

CO2 Vent Line



Thanks!

